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WO 01/31824 A1

(54) Title: APPARATUS AND METHOD FOR CONTROLLING A POWER OF REVERSE LINK IN CDMA SYSTEM

(57) Abstract: The present invention relates to a method of controlling transmiting power level of a mobile station in CDMA communication system. This invention estimates a moving speed of a mobile station and changes power control step size according to the estimated moving speed, thereby tracking power level control command, which is transmitted from a base station to compensate the power variation of its received signals, quickly and precisely.

DESCRIPTION

APPARATUS AND METHOD FOR CONTROLLING A POWER OF REVERSE LINK IN CDMA SYSTEM

1. Technical Field

The present invention relates to a method of controlling uplink (reverse link) power level in a code division multiple access (CDMA) communication system.

2. Background Art

In a conventional method conducting a closed-loop power control for a reverse link, a signal power from a mobile station (MS) is estimated at a base station (BTS), the estimated power is then compared with critical power magnitude required for maintaining signal quality. According to the comparison result, the BTS transmits a TPC (Transmit Power Control) bit for commanding the MS to increase or decrease current transmitting power level of a MS. Receiving the TPC bit, the MS interprets it and increments or decrements the transmitting power level stepwise. The power level adjusting resolution is 1.0dB.

FIG. 1 illustrates a functional block diagram of a power controlling unit installed in a mobile station.

A MS receives downlink (forwad link) signals from a neighboring BTS, then, an automatic gain controller (AGC) 11 adjusts its gain to flatten the received signal level, a demodulator 12 extracts the TPC bit from the received downlink signals, a TPC interpreter 13 interprets which operation the extracted TPC bit is requesting. A power level controller 15 determines whether to increment or decrement

closed-loop power level by the adjusting step P_{closed} based on the interpretation, and adds the determined $\pm P_{closed}$ to an open-loop power control level ΔP_{open}, which is determined by a RSSI 14 based on the level of the output signal of the AGC 11. A power adjusting signal for the total power control level ΔP_t ($=\Delta_{Popen} \pm P_{closed}$) is applied to a high-power amplifier (HPA) 16 from the power level controller 15 so that the current power level of uplink signals is adjusted by ΔP_t.

The power level of signals transmitted from a MS is estimated every 1.25 msec at a BTS. The time 1.25 msec is equal to duration of 6 Walsh symbols and is called a power control group (PCG). Therefore, sixteen power control groups are contained in a 20msec-long traffic frame.

A BTS transmits 1-bit TPC command to a MS based on the estimated power level every PCG. Thus, the power level controller 15 of a MS outputs the 1dB power increment signal to the HPA 16 if the value interpreted every 1.25 msec is '1', and it outputs 1dB power decrement signal if '0'.

However, the 1-bit TPC information is frequently distorted due to wireless environment, and if a receiving power level changes very rapidly or slowly (a power level changing speed is mainly affected by the moving speed of a MS), it is difficult to track the variation of the power level through the only 1dB increment or decrement.

For example, supposed that power level received at a BTS is the graph of P_{Rx} as shown in FIG. 2, it is ideal that the transmitting signal power level controlled by the power level controller 15 is the graph of P_{Tx}. However, 1dB step (ΔP) adjustment conducted every 1.25 msec can not track the graph P_{Tx} exactly as shown in FIG. 2 when the variation of power level to compensate is too sharp since the moving speed

of a MS is very high. In addition, when the variation of power level is too small, 1dB-step adjustment may cause an oscillation of transmitting power level.

3. Disclosure of Invention

It is an object of the present invention to provide an uplink power level controlling method of adjusting power control step size based on the moving speed of a mobile station in CDMA communication system.

It is another object of the present invention to provide an uplink power level controlling method of checking the reliability of power control command received from a BTS, and adjusting the transmitting power level based on the checked reliability.

The closed-loop uplink power controlling apparatus according to the present invention comprises: a channel estimator detecting power or phase of a specific channel of received downlink signals; a speed estimator estimating a moving speed of the mobile station based on the detected power or phase; a step adjuster changing the size of a power control step based on the estimated moving speed; a demodulator extracting a power control command contained in the received downlink signals; and a power level controller adjusting power level of transmitting signals by the changed power control step size according to the extracted power control command.

The closed-loop uplink power controlling method according to the present invention, receives downlink signals, detects power or phase of a specific channel of the received downlink signals, extracts power control command from the received downlink signals, estimates a moving speed of a mobile station based on the detected power or phase, measures the reliability of the extracted power control command, changes a power control step size based on the estimated moving speed,

and increases or decreases power level of transmitting signals by the changed power control step size according to the extracted power control command and its measured reliability.

This uplink power controlling method according to the present invention can optimize uplink transmitting power and prevent the quality of uplink signals from being degraded due to errors in transmitting power control information delivered from a BTS to a MS, thereby reducing power consumption of a MS, improving the quality of an uplink signal, and increasing the number of MSs admittable to a BTS.

4. Brief Description of Drawings

The accompanying drawings, which are included to provide a further understanding of the invention, illustrate the preferred embodiment of this invention, and together with the description, serve to explain the principles of the present invention.

In the drawings:

FIG. 1 illustrates a functional block diagram of a power controlling unit installed in a mobile station;

FIG. 2 is exemplary curves showing receiving power of a BTS and transmitting power of a MS controlled according to the power control command;

FIG. 3 illustrates a block diagram of a closed-loop power controlling unit according to the present invention; and

FIG. 4 is a flow diagram embodying an uplink closed-loop power level controlling method according to the present invention.

5. Modes for Carrying out the Invention

The accompanying drawings illustrate the preferred embodiments of the present invention, and together with the description, serve to explain the principles of the present invention.

FIG. 3 illustrates a block diagram of a closed-loop power controlling unit of a MS according to the present invention.

This power controlling unit of FIG. 3 comprises an AGC 31 flattening the level of downlink signals received from a neighboring BTS; a channel estimator 23 detecting magnitude and/or phase of pilot channel of output signals from the AGC 31; a speed estimator 33 estimating a moving speed of a MS based on the detected magnitude and phase of pilot channel; a step adjuster 34 adjusting a power controlling step size ($\triangle$P) based on the estimated moving speed; a demodulator 35 extracting TPC bits from the level-flattened downlink signals from the AGC 31; a TPC verifier 36 measuring how much reliable the extracted TPC bits are; a power level controller 37 outputting a power control signal commanding to increment or decrement current transmitting power level by the adjusted step size ($\triangle$P) according to the TPC bits whose reliability is measured by the TPC verifier 36; and a HPA 39 power-amplifying uplink signals, which has been modulated through a modulator 38, according to the power control signal.

The estimated moving speed of a MS is closely correlated with the slope of power level graph , for example, the graph P_{Rx} in FIG. 2, of uplink signals received at a BTS.

FIG. 4 is a flow diagram embodying an uplink closed-loop power level controlling method according to the present invention. This flow diagram conducted in the power controlling unit configured as FIG. 3 is explained in detail.

Downlink signals from a neighboring BTS is received at a MS, the AGC 31 flattens the average level of the received signals through adjusting its gain, and applies the level-flattened signals to the channel estimator 32 and the demodulator 35 at the same time (S1). The channel estimator

32 detects power magnitude and/or phase of the pilot channel of the downlink signals. The demodulator 35 demodulates the received downlink signals and extracts power control information, that is, TPC bit from the demodulated signals (S2).

The speed estimator 33 estimates the moving speed of a MS based on the detected power magnitude and/or phase of pilot channel. This estimating method is explained later.

The TPC verifier 36 measures the reliability of the extracted TPC bit in consideration of the history of TPC bits and the energy of the just-received TPC bit (S3). For example, the rules that the more recently a TPC bit was received, the larger a weighting factor used for the TPC bit is, and that the reliability is proportional to the energy magnitude detected within the just-received TPC bit may be used to measure the reliability. Considering such rules, a reliability measuring equation is derived as follows.

$$reliability(W) = \frac{\sum^{N} a_i TPC_i}{N} W_1 + E_{TPC} W_2$$

where weighting factor condition of $a_i > a_{i+1}$ should be satisfied since smaller i means nearer time to the present, N is the number of data sampled within a TPC bit, E_{TPC} is energy magnitude detected at a just-received TPC bit, and W_1 and W_2 are ratios to reflect how much the reliability is affected by the TPC history and the energy of the latest TPC bit, respectively. It is preferable that the condition of $W_1<W_2$ is satisfied.

The reliability measured according the above equation is used as a weighting factor for power controlling step size.

The step adjuster 34 determines and sets the power controlling step size ($\triangle$P) based on the estimated moving speed (S4). The step size is chosen within a range from 0.1dB

to 2dB. In this determination, the step size is chosen to or over 1dB to track the power variation quickly if the estimated moving speed is high, and it is chosen to or below 0.25dB to track the power variation slowly, if the moving speed is low or zero. If the speed is moderate, 0.5dB step is selected. This step size adjustment is conducted every 1.25 msec.

To simplify the step adjusting circuit, it is preferable that the adjustable step sizes are fixed to 0.25dB, 0.5dB, and 1dB.

Then, the power level controller 37 controls the HPA 39 such that the transmitting power of the HPA 39 is adjusted based on the step size set by the step adjuster 34 and the measured reliability (S5). That is, the transmitting power is increased as much as the set step size multiplied by the measured reliability, if the received TPC bit is '1', and it is decreased that much, if '0'.

The equations used for the above-explained power level control process are explained.

The speed estimator 33 calculates the level crossing rate (LCR) and average fade time (AFT) from the detected power magnitude of a pilot channel based on the following equations:

LCR = $n(\gamma - A) = N/T$, where A is reference level, and N is # of crossings over T - second length; and

AFT = $i(r-A) = \frac{\sum_{i=0}^{N} t_i}{N}$ where t_i is individual fade.

After these two values of LCR and AFT are obtained, a corresponding moving speed is picked out from a pre-specified table indicative of speed versus LCR and AFT. This table is derived from experiments and theoretical feature

that each of LCR and AFT is proportional to a moving speed of a MS.

The detected phase may be used to estimate the moving speed instead of the detected magnitude since the speed of phase variation is proportional to the moving speed of a MS, too.

If such moving speed estimation is done at the speed estimator 33, the step adjuster 34 determines the power control step size ($\triangle P$) corresponding to the picked moving speed. Then, the power level controller 37 calculates adjustment magnitude P_{ADJ} using the equation of P_{ADJ} = TPC $\times W \times N \times \triangle P$, where TPC is sign of TPC bit(± 1), W is measured reliability, N is min(C, $\triangle$Pmax/$\triangle$P) where C is the number of TPC bits indicative of power changes in the same direction, and $\triangle$Pmax is maximum step size.

After the adjustment magnitude P_{ADJ} is calculated, the power level controller 37 controls transmitting power of the HPA 39 to decrease or increase according to the equation of: next power level(P_n) = current power level (P_{n-1}) + P_{ADJ}.

C L A I M S

1. An apparatus of controlling uplink transmitting power in a CDMA mobile station, comprising:

a channel estimator detecting power magnitude and/or phase of a specific channel of received downlink signals;

a speed estimator estimating a moving speed of the mobile station based on the detected power magnitude and/or phase;

a step adjuster changing the size of a power control step based on the estimated moving speed;

a demodulator extracting a power control command contained in the received downlink signals; and

a power level controller adjusting power level of transmitting signals by the changed power control step size according to the extracted power control command.

2. The apparatus set forth in claim 1, wherein said specific channel is pilot channel.

3. The apparatus set forth in claim 1, further comprising a measuring means measuring the reliability of the extracted power control command, wherein said power level controller derives a weighting factor from the measured reliability, multiplies the changed power control step size by the derived weighting factor, and increments or decrements the power level of transmitting signals by the multiplied step size.

4. The apparatus set forth in claim 3, wherein said measuring means measures the reliability based on the energy magnitude of the extracted power control command and history of power control commands.

5. The apparatus set forth in claim 3, wherein the magnitude (P_{ADJ}) of power level adjusting step is determined by the equation of $P_{ADJ} = TPC \times W \times N \times \triangle P$, where TPC is sign of

TPC bit($\pm$1), W is measured reliability, N is min(C, $\triangle$Pmax/$\triangle$P) where C is the number of TPC bits indicative of power changes in the same direction, $\triangle$P is the changed power control step size, and $\triangle$Pmax is maximum step size.

6. A method of controlling uplink transmitting power in a CDMA communication system, comprising the steps of:

(a) receiving downlink signals;

(b) detecting power magnitude and/or phase of a specific channel of the received downlink signals, and extracting power control command from the received downlink signals;

(c) estimating a moving speed of a mobile station based on the detected power magnitude and/or phase;

(d) changing a power control step size based on the estimated moving speed; and

(e) increasing or decreasing power level of transmitting signals by the changed power control step size according to the extracted power control command.

7. The method set forth in claim 6, wherein said step (d) conducts the step changing operation every 1.25 msec.

8. A method of controlling uplink transmitting power in a CDMA communication system, comprising the steps of:

(a) receiving downlink signals;

(b) extracting power control command from the received downlink signals;

(c) calculating the reliability of the extracted power control command;

(d) deriving a weighting factor from the calculated reliability and multiplying a determined power control step size by the derived weighting factor; and

(e) increasing or decreasing power level of transmitting signals by the multiplied power control step size according to the extracted power control command.

FIG. 1

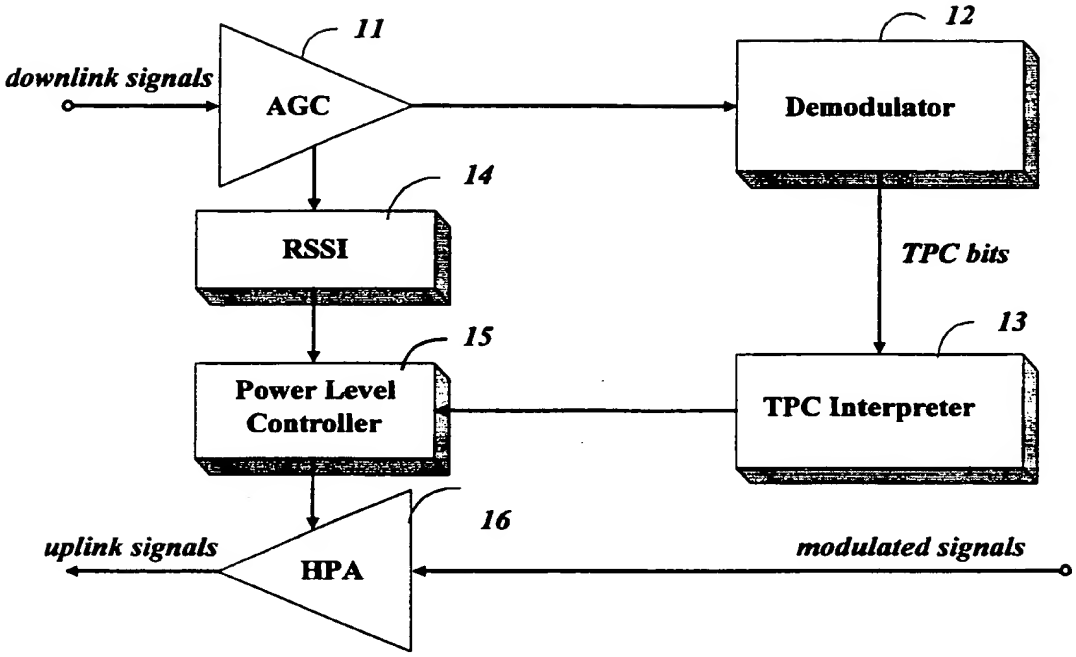

11
12
downlink signals
AGC
Demodulator
14
RSSI
TPC bits
15
13
Power Level Controller
TPC Interpreter
16
uplink signals
HPA
modulated signals

FIG. 2

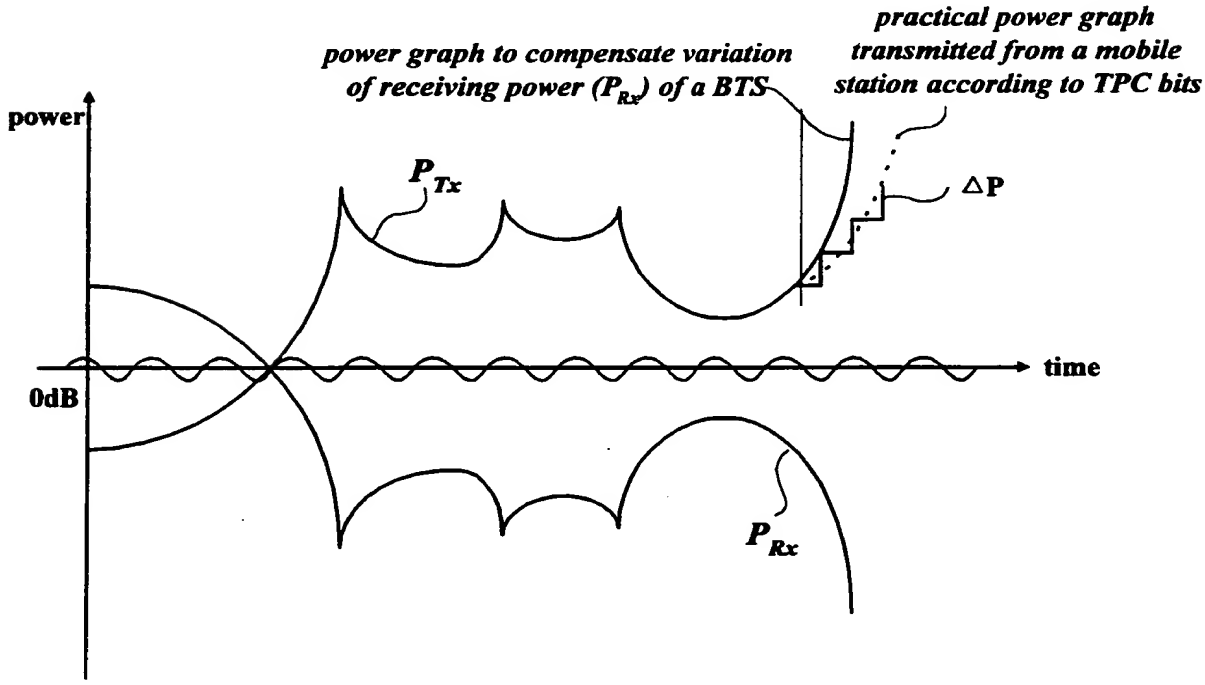

power graph to compensate variation of receiving power (P_{Rx}) of a BTS
practical power graph transmitted from a mobile station according to TPC bits
power
P_{Tx}
ΔP
time
0dB
P_{Rx}

FIG. 3

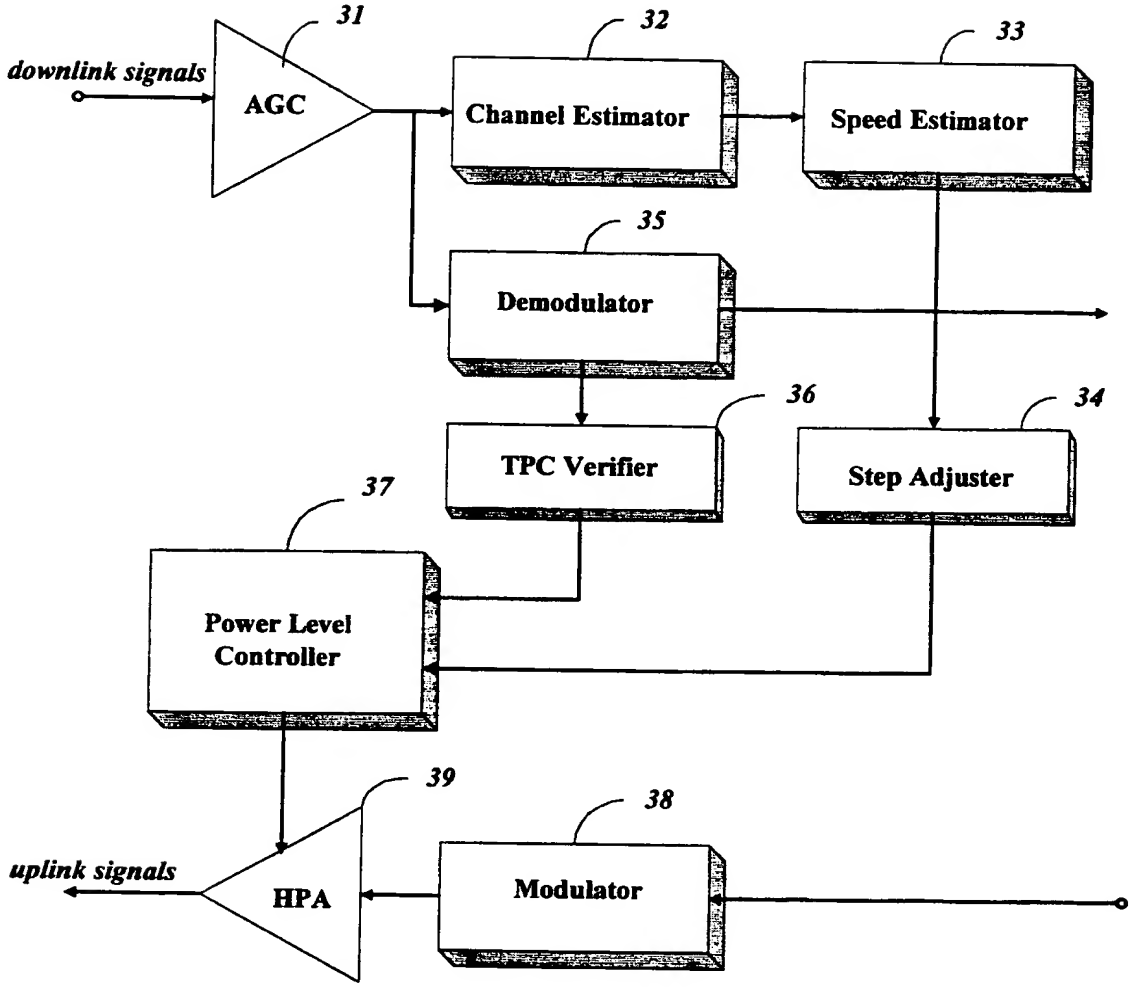
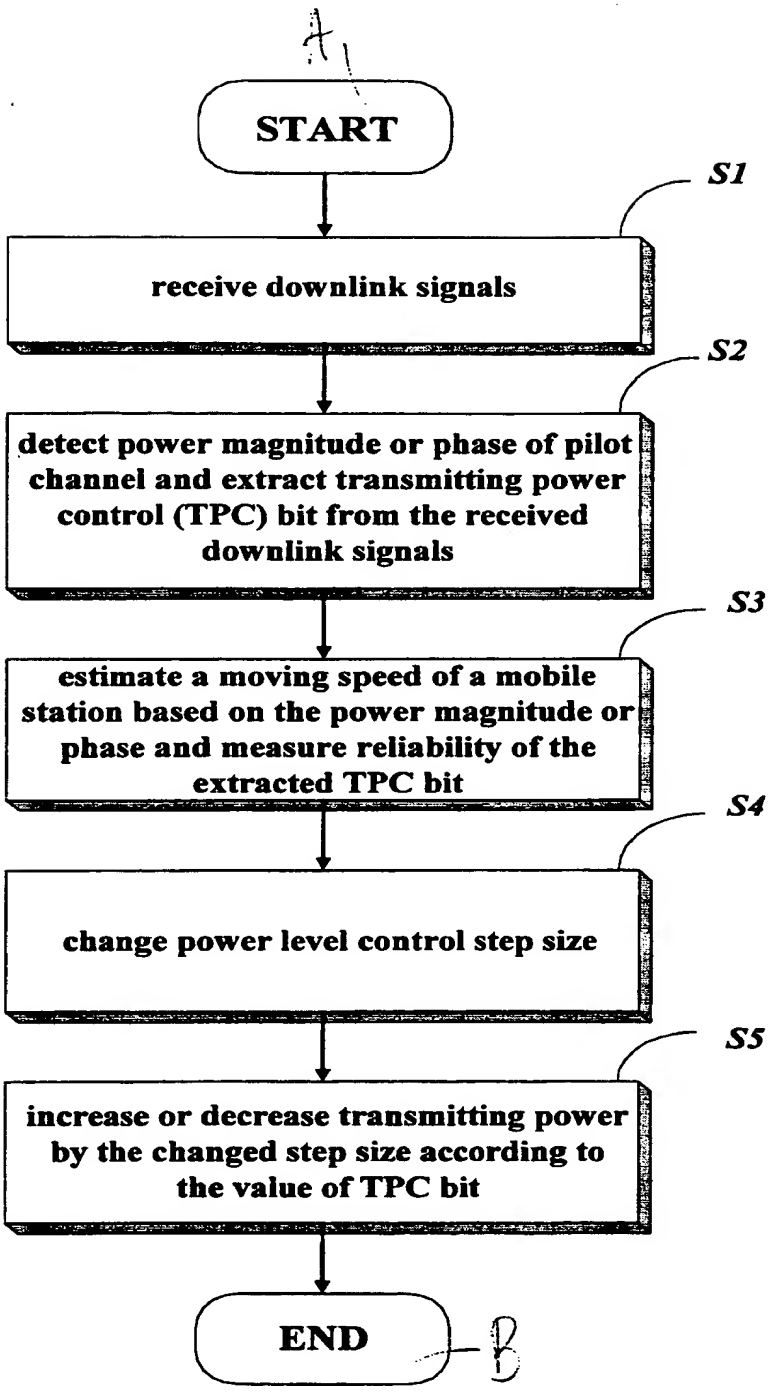

downlink signals
AGC
31
Channel Estimator
32
Speed Estimator
33
Demodulator
35
TPC Verifier
36
Step Adjuster
34
Power Level Controller
37
uplink signals
HPA
39
Modulator
38

FIG. 4


A
START
S1
receive downlink signals
S2
detect power magnitude or phase of pilot channel and extract transmitting power control (TPC) bit from the received downlink signals
S3
estimate a moving speed of a mobile station based on the power magnitude or phase and measure reliability of the extracted TPC bit
S4
change power level control step size
S5
increase or decrease transmitting power by the changed step size according to the value of TPC bit
END
B

INTERNATIONAL SEARCH REPORT

international application No.
PCT/KR00/01192

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 H04J 13/00, H04B 7/00, H04B 1/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimun documentation searched (classification system followed by classification symbols)

KR, JP, US, EP classes as above

Documentation searched other than minimun documentation to the extent that such documents are included in the fileds searched

Korean Patents and applications for invention since 1975
Korean Utility models and applications for Utility models since 1975

Electronic data base consulted during the intertnational search (name of data base and, where practicable, search trerms used)

NPS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-99-0067643(Qualcomm Incorporated) 25 AUG. 1999 col.5, col. 8~ col. 21	1 ~ 8
Y	KR 10-99-0051291(SK Telecom.) 5 JUL. 1999 abstract, col. 4 ~ col. 6, fig. 10	1 ~ 8

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevence
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevence; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevence; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 JANUARY 2001 (30.01.2001)	31 JANUARY 2001 (31.01.2001)

Name and mailing address of the ISA/KR
Korean Industrial Property Office
Government Complex-Taejon, Dunsan-dong, So-ku, Taejon
Metropolitan City 302-701, Republic of Korea
Facsimile No. 82-42-472-7140

Authorized officer
JEONG, Yong Joo
Telephone No. 82-42-481-5674

PAT' 'T COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

To:
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1 Fl., Dongun Bldg.
413-4, Dogok 2-dong
Kangnam-gu
Seoul 135-272
RÉPUBLIQUE DE CORÉE

RECEIVED 2001. 5. 21

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

Date of mailing (day/month/year) 03 May 2001 (03.05.01)	
Applicant's or agent's file reference P01632DP	**IMPORTANT NOTICE**

International application No.	**International filing date** (day/month/year)	**Priority date** (day/month/year)
PCT/KR00/01192	21 October 2000 (21.10.00)	26 October 1999 (26.10.99)

Applicant
SK TELECOM CO., LTD. et al

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
   US

   In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:
   CN,EP,JP

   The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on
   03 May 2001 (03.05.01) under No. WO 01/31824

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, **a demand for international preliminary examination** must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the **national phase**, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO
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1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR00/01192

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 H04J 13/00, H04B 7/00, H04B 1/06

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Electronic data base consulted during the intertnational search (name of data base and, where practicable, search trerms used)

NPS

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☐ Further documents are listed in the continuation of Box C.

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevence; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevence; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 JANUARY 2001 (30.01.2001)	31 JANUARY 2001 (31.01.2001)

Name and mailing address of the ISA/KR	Authorized officer
Korean Industrial Property Office Government Complex-Taejon, Dunsan-dong, So-ku, Taejon Metropolitan City 302-701, Republic of Korea Facsimile No. 82-42-472-7140	JEONG, Yong Joo Telephone No. 82-42-481-5674

Form PCT/ISA/210 (second sheet) (July 1998)

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* P01632DP

Box No. I TITLE OF INVENTION

APPARATUS AND METHOD FOR CONTROLLING A POWER OF REVERSE LINK IN CDMA SYSTEM

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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99, Seorin-dong, Jongro-ku,
Seoul, 110-110, Republic of Korea

☐ This person is also inventor.

Telephone No. 031) 710-5027

Facsimile No. 031) 710-5099

Teleprinter No.

State *(that is, country)* of nationality: KR

State *(that is, country)* of residence: KR

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

LEE, Dong Do
610-501, Ssangyong Apt., Pureun Maeul,
Sunae-dong, Bundang-gu, Sungnam,
Kyunggi-do, 463-781,
Republic of Korea

This person is:

☐ applicant only

☒ applicant and inventor

☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: KR

State *(that is, country)* of residence: KR

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

PARK, Lae Bong
1Fl., Dongun Bldg., 413-4, Dogok 2-dong,
Kangnam-gu, Seoul, 135-272,
Republic of Korea

Telephone No. 02) 529-4635

Facsimile No. 02) 529-4636

Teleprinter No.

☐ **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Continuation of Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

If none of the following sub-boxes is used, this sheet should not be included in the request.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

LEE, Sang Yun
305-1502, Saetbyul Woobang Apt.,
Bundang-dong, Bundang-gu, Sungnam,
Kyunggi-do, 463-750,
Republic of Korea

This person is:
- [ ] applicant only
- [X] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: KR

State *(that is, country)* of residence: KR

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [X] the United States of America only
- [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

KIM, Byung Moo
115-707, Saemmaeul, Hogye-dong,
Dongan-gu, Anyang, Kyunggi-do, 431-080,
Republic of Korea

This person is:
- [ ] applicant only
- [X] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: KR

State *(that is, country)* of residence: KR

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- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

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State *(that is, country)* of residence:

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- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality:

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- [ ] the United States of America only
- [ ] the States indicated in the Supplemental Box

- [ ] Further applicants and/or (further) inventors are indicated on another continuation sheet.

Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked)*:

Regional Patent

☐ AP **ARIPO Patent:** GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SL Sierra Leone, SZ Swaziland, TZ United Republic of Tanzania, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT

☐ EA **Eurasian Patent:** AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT

☒ EP **European Patent:** AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT

☐ OA **OAPI Patent:** BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

☐ AE United Arab Emirates
☐ AL Albania
☐ AM Armenia
☐ AT Austria
☐ AU Australia
☐ AZ Azerbaijan
☐ BA Bosnia and Herzegovina
☐ BB Barbados
☐ BG Bulgaria
☐ BR Brazil
☐ BY Belarus
☐ CA Canada
☐ CH and LI Switzerland and Liechtenstein
☒ CN China
☐ CR Costa Rica
☐ CU Cuba
☐ CZ Czech Republic
☐ DE Germany
☐ DK Denmark
☐ DM Dominica
☐ EE Estonia
☐ ES Spain
☐ FI Finland
☐ GB United Kingdom
☐ GD Grenada
☐ GE Georgia
☐ GH Ghana
☐ GM Gambia
☐ HR Croatia
☐ HU Hungary
☐ ID Indonesia
☐ IL Israel
☐ IN India
☐ IS Iceland
☒ JP Japan
☐ KE Kenya
☐ KG Kyrgyzstan
☐ KP Democratic People's Republic of Korea
☐ KR Republic of Korea
☐ KZ Kazakhstan
☐ LC Saint Lucia
☐ LK Sri Lanka
☐ LR Liberia
☐ LS Lesotho
☐ LT Lithuania
☐ LU Luxembourg
☐ LV Latvia
☐ MA Morocco
☐ MD Republic of Moldova
☐ MG Madagascar
☐ MK The former Yugoslav Republic of Macedonia
☐ MN Mongolia
☐ MW Malawi
☐ MX Mexico
☐ NO Norway
☐ NZ New Zealand
☐ PL Poland
☐ PT Portugal
☐ RO Romania
☐ RU Russian Federation
☐ SD Sudan
☐ SE Sweden
☐ SG Singapore
☐ SI Slovenia
☐ SK Slovakia
☐ SL Sierra Leone
☐ TJ Tajikistan
☐ TM Turkmenistan
☐ TR Turkey
☐ TT Trinidad and Tobago
☐ TZ United Republic of Tanzania
☐ UA Ukraine
☐ UG Uganda
☒ US United States of America
☐ UZ Uzbekistan
☐ VN Viet Nam
☐ YU Yugoslavia
☐ ZA South Africa
☐ ZW Zimbabwe

Check-boxes reserved for designating States which have become party to the PCT after issuance of this sheet:

☐ .....
☐ .....

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)*

Box No. VI PRIORITY CLAIM ☐ Further priority claims are indicated in the Supplemental Box.

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is: national application: country	regional application:* regional Office	international application: receiving Office
item (1) 26 October 1999 (26/10/99)	1999-46523	KR		
item (2)				
item (3)				

☐ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office)* identified above as item(s): _____

* *Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.*

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):*

ISA / KR

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority):*

Date *(day/month/year)* Number Country *(or regional Office)*

Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following number of sheets:

request	:	4
description (excluding sequence listing part)	:	8
claims	:	3
abstract	:	1
drawings	:	3
sequence listing part of description	:	
Total number of sheets	:	19

This international application is accompanied by the item(s) marked below:

1. ☐ fee calculation sheet
2. ☒ separate signed power of attorney
3. ☐ copy of general power of attorney; reference number, if any:
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language):
7. ☐ separate indications concerning deposited microorganism or other biological material
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☐ other *(specify)*:

Figure of the drawings which should accompany the abstract: FIG.3

Language of filing of the international application: Korean

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

PARK, Lae Bong

For receiving Office use only

1. Date of actual receipt of the purported international application:	2. Drawings: ☐ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:	
4. Date of timely receipt of the required corrections under PCT Article 11(2):	
5. International Searching Authority (if two or more are competent): ISA/	6. ☐ Transmittal of search copy delayed until search fee is paid.

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

RECORD COPY

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

PCT/KR 00/01192
International Application No.

21 October 2000 (21.10.00)
International Filing Date

Korean Industrial Property Office
International Application
Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* P01632DP

Box No. I TITLE OF INVENTION

APPARATUS AND METHOD FOR CONTROLLING A POWER OF REVERSE LINK IN CDMA SYSTEM

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

SK Telecom Co., Ltd.
99, Seorin-dong, Jongro-ku,
Seoul, 110-110, Republic of Korea

☐ This person is also inventor.

Telephone No. 031) 710-5027

Facsimile No. 031) 710-5099

Teleprinter No.

State *(that is, country)* of nationality: KR

State *(that is, country)* of residence: KR

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

LEE, Dong Do
610-501, Ssangyong Apt., Pureun Maeul,
Sunae-dong, Bundang-gu, Sungnam,
Kyunggi-do, 463-781,
Republic of Korea

This person is:

☐ applicant only

☒ applicant and inventor

☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: KR

State *(that is, country)* of residence: KR

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

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1Fl., Dongun Bldg., 413-4, Dogok 2-dong,
Kangnam-gu, Seoul, 135-272,
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Telephone No. 02) 529-4635

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Continuation of Box No. III **FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)**

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305-1502, Saetbyul Woobang Apt.,
Bundang-dong, Bundang-gu, Sungnam,
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- [X] applicant and inventor
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KIM, Byung Moo
115-707, Saemmaeul, Hogye-dong,
Dongan-gu, Anyang, Kyunggi-do, 431-080,
Republic of Korea

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- [X] applicant and inventor
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- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

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- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [ ] the United States of America only
- [ ] the States indicated in the Supplemental Box

- [ ] Further applicants and/or (further) inventors are indicated on another continuation sheet.

Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked)*:

Regional Patent

☐ **AP** **ARIPO Patent:** **GH** Ghana, **GM** Gambia, **KE** Kenya, **LS** Lesotho, **MW** Malawi, **SD** Sudan, **SL** Sierra Leone, **SZ** Swaziland, **TZ** United Republic of Tanzania, **UG** Uganda, **ZW** Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT

☐ **EA** **Eurasian Patent:** **AM** Armenia, **AZ** Azerbaijan, **BY** Belarus, **KG** Kyrgyzstan, **KZ** Kazakhstan, **MD** Republic of Moldova, **RU** Russian Federation, **TJ** Tajikistan, **TM** Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT

☒ **EP** **European Patent:** **AT** Austria, **BE** Belgium, **CH and LI** Switzerland and Liechtenstein, **CY** Cyprus, **DE** Germany, **DK** Denmark, **ES** Spain, **FI** Finland, **FR** France, **GB** United Kingdom, **GR** Greece, **IE** Ireland, **IT** Italy, **LU** Luxembourg, **MC** Monaco, **NL** Netherlands, **PT** Portugal, **SE** Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT

☐ **OA** **OAPI Patent:** **BF** Burkina Faso, **BJ** Benin, **CF** Central African Republic, **CG** Congo, **CI** Côte d'Ivoire, **CM** Cameroon, **GA** Gabon, **GN** Guinea, **GW** Guinea-Bissau, **ML** Mali, **MR** Mauritania, **NE** Niger, **SN** Senegal, **TD** Chad, **TG** Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

☐ **AE** United Arab Emirates
☐ **AL** Albania
☐ **AM** Armenia
☐ **AT** Austria
☐ **AU** Australia
☐ **AZ** Azerbaijan
☐ **BA** Bosnia and Herzegovina
☐ **BB** Barbados
☐ **BG** Bulgaria
☐ **BR** Brazil
☐ **BY** Belarus
☐ **CA** Canada
☐ **CH and LI** Switzerland and Liechtenstein
☒ **CN** China
☐ **CR** Costa Rica
☐ **CU** Cuba
☐ **CZ** Czech Republic
☐ **DE** Germany
☐ **DK** Denmark
☐ **DM** Dominica
☐ **EE** Estonia
☐ **ES** Spain
☐ **FI** Finland
☐ **GB** United Kingdom
☐ **GD** Grenada
☐ **GE** Georgia
☐ **GH** Ghana
☐ **GM** Gambia
☐ **HR** Croatia
☐ **HU** Hungary
☐ **ID** Indonesia
☐ **IL** Israel
☐ **IN** India
☐ **IS** Iceland
☒ **JP** Japan
☐ **KE** Kenya
☐ **KG** Kyrgyzstan
☐ **KP** Democratic People's Republic of Korea
☐ **KR** Republic of Korea
☐ **KZ** Kazakhstan
☐ **LC** Saint Lucia
☐ **LK** Sri Lanka
☐ **LR** Liberia
☐ **LS** Lesotho
☐ **LT** Lithuania
☐ **LU** Luxembourg
☐ **LV** Latvia
☐ **MA** Morocco
☐ **MD** Republic of Moldova
☐ **MG** Madagascar
☐ **MK** The former Yugoslav Republic of Macedonia
☐ **MN** Mongolia
☐ **MW** Malawi
☐ **MX** Mexico
☐ **NO** Norway
☐ **NZ** New Zealand
☐ **PL** Poland
☐ **PT** Portugal
☐ **RO** Romania
☐ **RU** Russian Federation
☐ **SD** Sudan
☐ **SE** Sweden
☐ **SG** Singapore
☐ **SI** Slovenia
☐ **SK** Slovakia
☐ **SL** Sierra Leone
☐ **TJ** Tajikistan
☐ **TM** Turkmenistan
☐ **TR** Turkey
☐ **TT** Trinidad and Tobago
☐ **TZ** United Republic of Tanzania
☐ **UA** Ukraine
☐ **UG** Uganda
☒ **US** United States of America
☐ **UZ** Uzbekistan
☐ **VN** Viet Nam
☐ **YU** Yugoslavia
☐ **ZA** South Africa
☐ **ZW** Zimbabwe

Check-boxes reserved for designating States which have become party to the PCT after issuance of this sheet:

☐ .....
☐ .....

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)*

Box No. VI PRIORITY CLAIM ☐ Further priority claims are indicated in the Supplemental Box.

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is: national application: country	regional application:* regional Office	international application: receiving Office
item (1) 26 October 1999 (26/10/99)	1999-46523	KR		
item (2)				
item (3)				

☐ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office)* identified above as item(s):

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Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):*

ISA/ KR

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority):*

Date *(day/month/year)* Number Country *(or regional Office)*

Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following **number of sheets**:

request	:	4
description (excluding sequence listing part)	:	8
claims	:	3
abstract	:	1
drawings	:	3
sequence listing part of description	:	
Total number of sheets	:	19

This international application is **accompanied by** the item(s) marked below:

1. ☐ fee calculation sheet
2. ☒ separate signed power of attorney
3. ☐ copy of general power of attorney; reference number, if any:
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language):
7. ☐ separate indications concerning deposited microorganism or other biological material
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☐ other *(specify)*:

Figure of the drawings which should accompany the abstract: FIG.3

Language of filing of the international application: Korean

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

PARK, Lae Bong

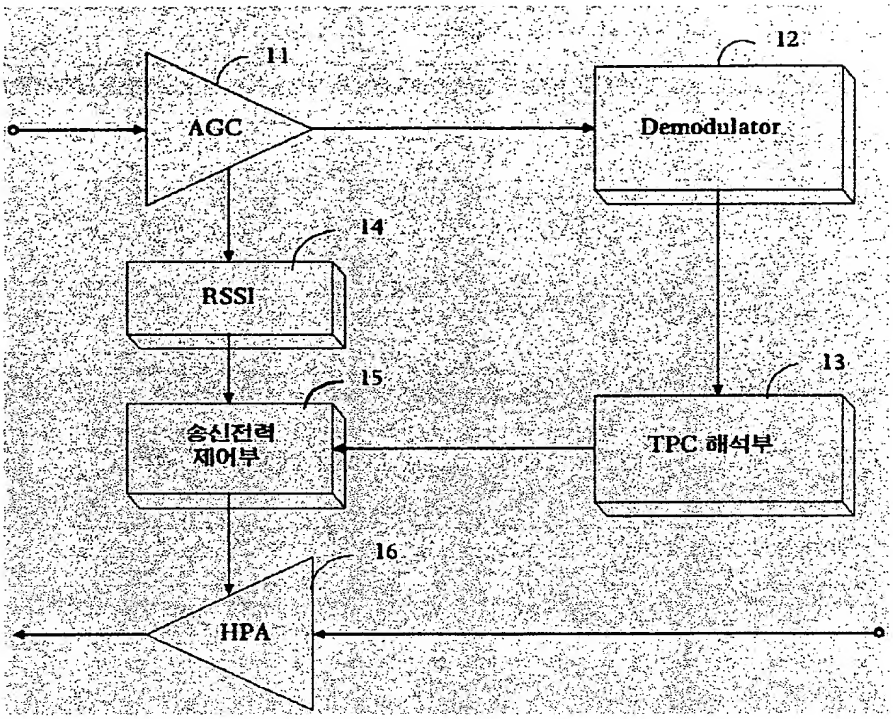
For receiving Office use only

1. Date of actual receipt of the purported international application: 21 October 2000 (21.10.00)
2. Drawings: ☐ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
4. Date of timely receipt of the required corrections under PCT Article 11(2):
5. International Searching Authority (if two or more are competent): ISA/KR
6. ☐ Transmittal of search copy delayed until search fee is paid.

For International Bureau use only

Date of receipt of the record copy by the International Bureau: 14 NOV 2000 (14.11.00)

【도 1】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AGC
12
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RSSI
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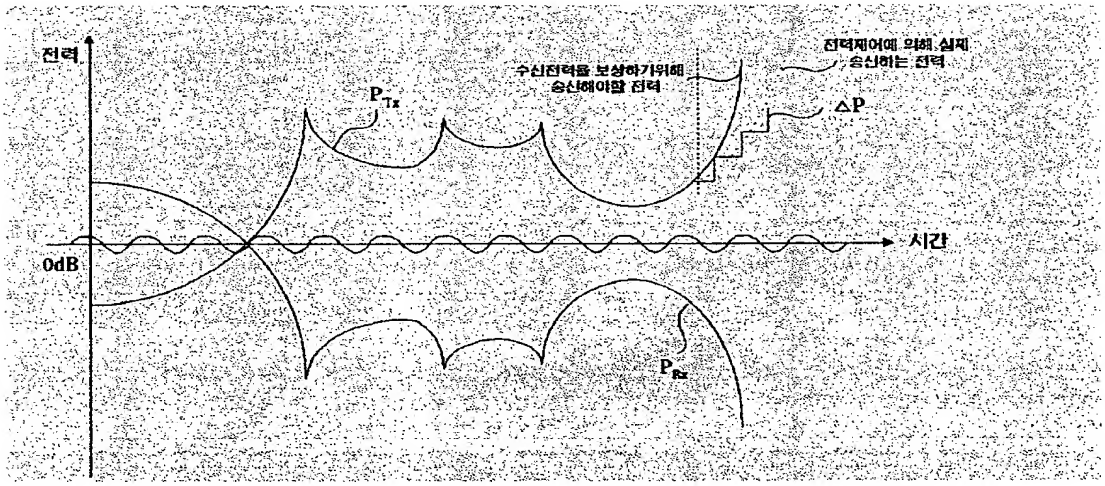
송신전력
제어부
13
TPC 해석부
16
HPA

【도 2】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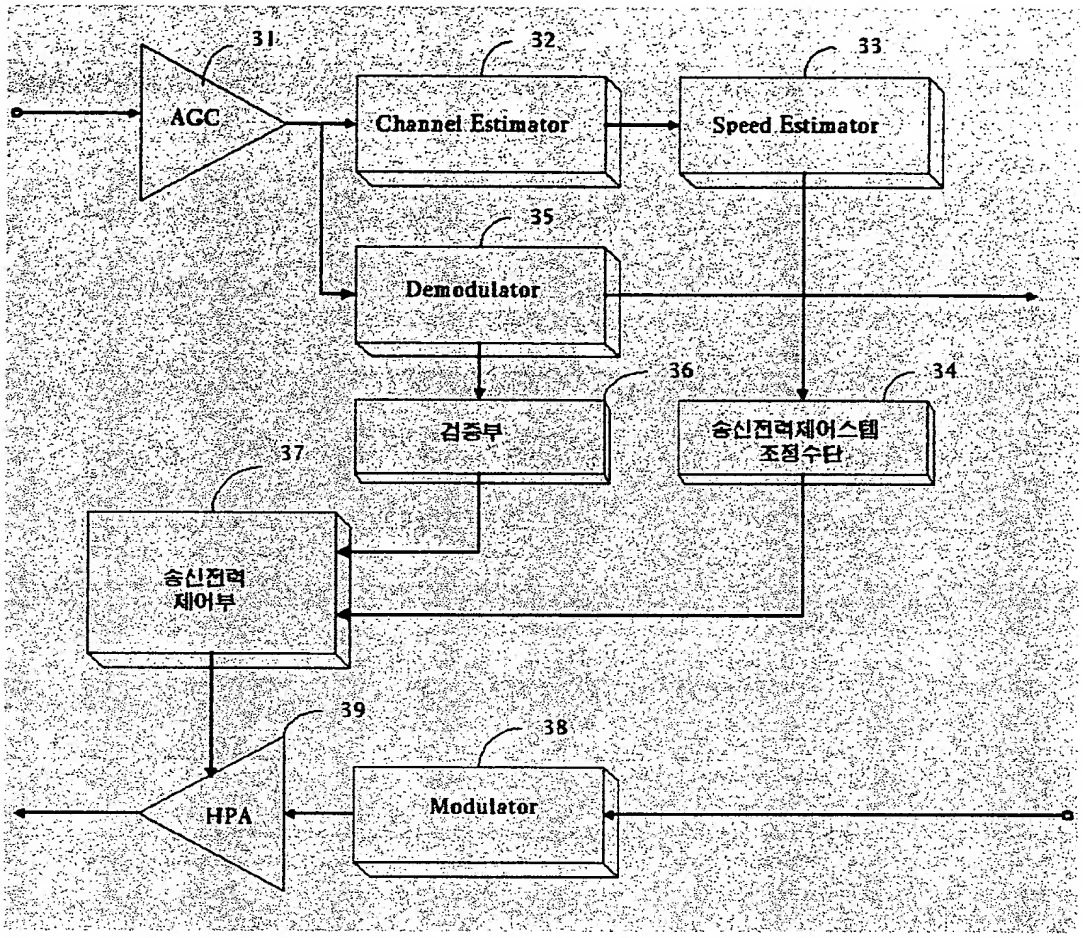
송신해야할 전력
전력제어에 의해 실제
송신하는 전력
△P
시간
0dB
P_{Rx}

【도 3】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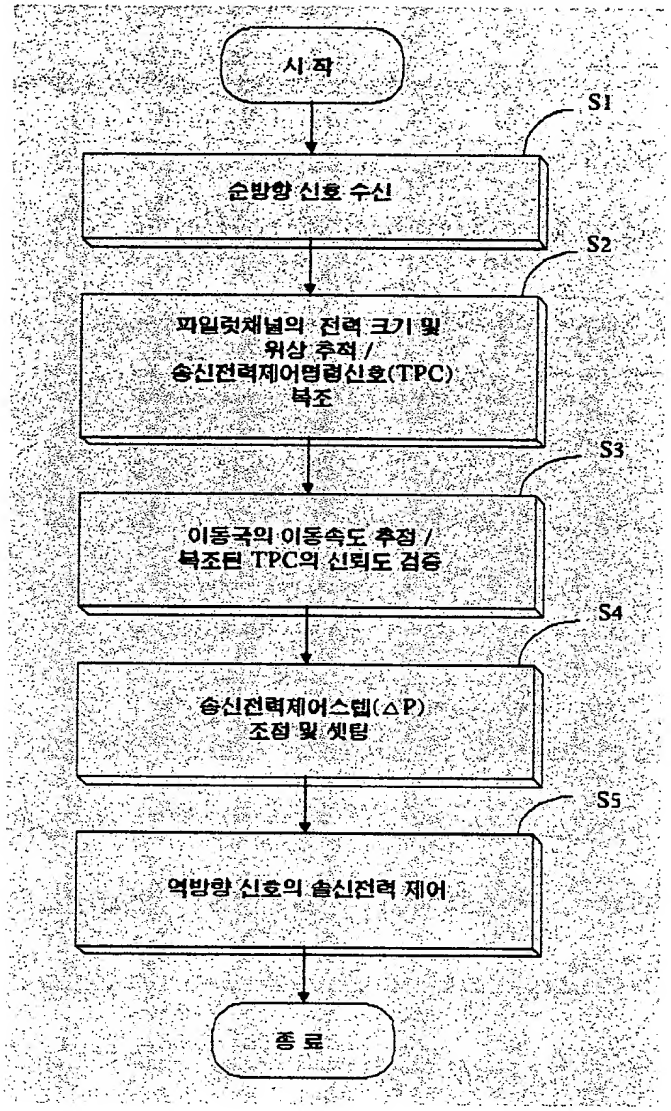
AGC
32
Channel Estimator
33
Speed Estimator
35
Demodulator
36
검증부
34
송신전력제어스텝
조정수단
37
송신전력
제어부
39
HPA
38
Modulator

【도 4】


시 작
S1
순방향 신호 수신
S2
파일럿채널의 전력 크기 및 위상 추적 / 송신전력제어명령신호(TPC) 복조
S3
이동국의 이동속도 추정 / 복조된 TPC의 신뢰도 검증
S4
송신전력제어스텝(△P) 조정 및 셋팅
S5
역방향 신호의 송신전력 제어
종 료

명 세 서

부호분할 다중접속 시스템에서의 역방향 링크의 전력 제어 장치 및 방법

1. 기술분야

본 발명은 부호분할 다중접속 시스템방식의 이동통신망에서의 역방향 링크의 전력을 제어하는 장치 및 방법에 관한 것이다.

2. 배경기술

종래의 부호분할 다중접속 방식의 통신 시스템에서는, 역방향 폐루프 전력 제어를 수행하기 위하여 이동국에서 전송한 신호의 세기를 기지국에서 추정하고, 그 추정된 신호의 세기와 일정 품질을 유지하기 위해 요구되는 기준신호의 세기와 비교한 후, 그 비교 결과에 따라 이동국에게 송신전력증가 또는 송신전력감소 명령(Transmit Power Control bit : 이하 TPC라 약칭함)을 송신하게 된다. 이때, 이동국은 상기 TPC 명령을 수신/해석하여, 그 해석 결과에 따라 미리 정해진 크기만큼 일정크기의 전력을 올리거나 내려서 역방향 신호를 송신한다.

즉, 도 1에 도시된 바와 같이, 이동국은 기지국으로부터 송신된 순방향 신호를 수신하여 자동이득조정증폭기(11)를 통해 이득을 조정하고, 복조기(12)를 통해 상기 TPC 명령 신호를 복조한 후, TPC 해석부(13)를 통해 상기 복조된 TPC 명령 신호를 해석하고, 이어 송신전력 제어부(15)는 상기 해석된 TPC 명령 신호 및 상

기 자동이득증폭기(11)와 알에스에스아이(RSSI)(14)를 통한 개루프 전력제어신호에 의거하여 송신전력 증/감 제어신호(Pt : $P_t = P_{open} + P_{closed}$)를 출력함으로써, 종단 고출력 증폭기(HPA)(16)의 출력전력레벨이 증/감되도록 제어한다.

이동국의 송신 신호는 기지국에 수신되어 6개의 왈시 심볼(Walsh Symbol)에 해당하는 1.25msec마다 특정 이동국으로부터 오는 역방향 무선링크의 품질을 추정하며, 이때의 1.25msec의 무선링크 품질측정 구간을 전력제어그룹이라 하며 20msec의 음성신호 한 프레임에는 16개의 전력제어그룹이 포함된다. 기지국에서는 이 추정치에 근거하여 1비트의 TPC 명령을 순방향 트래픽 채널을 통해 매 전력제어 그룹마다 이동국에 전송한다. 따라서, 상기 TPC 해석부(13)는 매 1.25msec마다 해석되는 TPC 1비트가 '0'이면 1dB 증가 '1'이면 1dB감소되도록 하는 송신전력 증/감 신호를 출력하여 역방향 신호의 전력레벨을 제어하는 것이다.

그러나, 이와 같은 종래의 역방향 폐루프 전력 제어 방식은, 1 비트의 TPC 데이터의 전송시 무선환경에서의 오류 발생 빈도가 높으며, 또한 1 비트의 TPC 신호에 의한 전력 증감 스텝(step)의 크기가 현재 1dB인 데, 이 전력 증감 스텝 폭으로는 이동국의 속도에 따르는 수신전력의 변화가 매우 느리거나 빠른 경우에는 그 변화를 정확히 보상할 수 없는 문제가 발생하였다.

즉, 도 2에서, 기지국에 수신된 신호의 전력레벨이 곡선 P_{Rx}와 같을 때, 이동국의 상기 송신전력제어부(15)에서 출력되는 송신 전력제어레벨은 곡선 P_{Tx}와 같이 되어야 이상적인 데, 상기 설명된 바와 같이 매 1.25msec마다 1dB씩 증감되는 기

존의 TPC 제어 스텝(△P)으로는, 이동국의 속도에 따르는 수신전력 곡선 P_{Rx}의 기울기의 변화가 너무 느리거나 빠른 경우, 상기 곡선 P_{Tx}를 세밀하게 추종하지 못하는 문제가 발생됨을 알 수 있다.

3. 발명의 상세한 설명

본 발명은 상기와 같은 종래의 문제점을 해결하기 위하여 창작된 것으로서, 그 목적은 이동국의 속도에 따라 송신전력제어스텝의 크기를 가변적으로 제어함으로써 역방향 송신 신호의 전력 레벨을 최적화 하도록 된 부호분할 다중접속 시스템에서의 역방향 링크의 전력 제어 장치 및 방법을 제공하고자 하는 것이다.

본 발명의 다른 목적은 송신전력 제어명령신호에 대한 신뢰도를 검증하여 오류를 회복할 수 있도록 된 부호분할 다중접속 시스템에서의 역방향 링크의 전력 제어 장치 및 방법을 제공하고자 하는 것이다.

상기와 같은 목적을 달성하기 위하여 본 발명에 따른 부호분할 다중접속 시스템에서의 역방향 링크의 전력 제어 장치는, 부호분할 다중접속 시스템의 역방향 폐루프 전력 제어 장치에 있어서, 수신된 순방향 신호의 특정 채널의 크기와 위상을 추정하는 채널추정수단; 상기 추정된 신호의 크기와 위상에 의거하여 이동국의 이동속도를 추정하는 속도추정수단; 상기 추정된 속도에 의거하여 이동국의 송신전력제어스텝의 크기를 가변적으로 조정하는 송신전력제어스텝 조정수단; 상기 수신된 순방향 신호에서 송신전력제어명령신호를 복조하는 복조수단; 상기 복조된 송신전력제어명령신호의 신뢰도를 검증하는 검증수단; 및 상기 조정된 송신전력제어스텝 및

상기 검증된 송신전력제어명령신호에 의거하여 송신전력을 제어하는 송신전력제어 수단을 포함하여 구성된다.

상기와 같은 목적을 달성하기 위하여 본 발명에 따른 부호분할 다중접속 시스템에서의 역방향 링크의 전력 제어 방법은, 부호분할 다중접속 시스템의 역방향 폐루프 전력 제어 방법에 있어서, 순방향 신호를 수신하는 제 1 단계; 상기 수신된 순방향 신호의 특정채널의 크기와 위상을 추정함과 아울러, 그 순방향신호에서 송신전력제어명령신호를 복조하는 제 2 단계; 상기 추정된 크기와 위상에 의거하여 이동국의 이동속도를 추정함과 아울러, 상기 복조된 송신전력제어명령신호의 신뢰도를 검증하는 제 3 단계; 상기 추정된 이동국의 이동속도에 의거하여 이동국의 송신전력제어스텝의 크기를 가변적으로 조정하는 제 4 단계; 및 상기 조정된 송신전력제어스텝 및 상기 검증된 송신전력제어명령신호에 의거하여 역방향 신호의 송신전력을 제어하는 제 5 단계를 포함하여 구성된다.

상기와 같은 특징을 갖는 본 발명에 따른 부호분할 다중접속 시스템에서의 역방향 링크의 전력 제어 장치 및 방법에 의하면, 기지국 수신전력곡선의 경사를 결정하는 이동국의 속도에 따라 송신전력제어스텝의 크기를 가변적으로 하여, 역방향 송신 신호의 전력 레벨을 최적화하고, 또한 송신전력제어명령신호(TPC)에 대한 신뢰도를 검증하여 오류를 회복할 수 있도록 하여, TPC 오류에 의한 역방향 신호 품질의 저하를 최소화함으로써, 역방향 신호 품질을 향상시키는 효과가 있다. 이에 따라 이동국의 배터리 소모를 줄일 수 있음은 물론 CDMA 시스템의 용량을 증대시킬 수

있다.

4. 도면의 간단한 설명

도 1은 종래의 이동국의 역방향 전력제어 장치의 블록도.

도 2는 기지국에서의 전력제어를 설명하기 위한 수신전력곡선 및 제어된 송신 전력곡선

도 3은 본 발명의 일 실시예에 따른 CDMA 시스템의 역방향 폐루프 전력 제어장치의 블록도.

도 4는 본 발명의 일 실시예에 따른 CDMA 시스템의 역방향 폐루프 전력 제어 방법의 흐름도이다.

5. 발명의 실시를 위한 형태

이하, 첨부 도면을 참조하여 본 발명의 바람직한 실시예에 따른 부호분할 다중접속 시스템(CDMA)에서의 역방향 링크의 전력 제어 장치에 대하여 상세히 설명하기로 한다.

도 3은 본 발명의 일 실시예에 따른 CDMA 시스템의 역방향 폐루프 전력 제어장치의 블록도로서, 기지국으로부터 이동국에 수신된 순방향 신호의 이득을 조정하는 자동이득조정 증폭기(AGC)(31); 상기 자동이득조정 증폭기(32)로부터 출력된 순방향 신호의 파이럿 채널의 크기와 위상을 추정하는 채널 추정기(Channel Estimator)(23); 상기 채널 추정기(Channeal Estimator)(32)에서 추정된 파이럿 채널의 크기와 위상에 의거하여 이동국의 이동속도(참고로, 이동국의 속도에 의해 도

2의 P_{Rx}곡선의 경사가 결정됨)를 추정하는 속도 추정기(Speed Estimator)(33): 상기 속도 추정기(33)에서 추정된 이동국의 이동속도에 의거하여 송신전력제어스텝(△P)의 크기를 가변적으로 조정하하여 세팅(setting)하는 송신전력제어스텝 조정부(34): 상기 자동이득조정 증폭기(31)로부터 이득조정되어 출력된 순방향 신호를 복조하는 복조기(Demodulator)(35): 상기 복조기(35)에 의해 복조된 송신전력제어명령신호(TPC)의 신뢰도를 검증하는 검증부(36): 및 상기 송신전력제어스텝 조정부(34)를 통해 조정/세팅된 송신전력제어스텝(△P) 및 상기 검증부(35)를 통해 검증된 송신전력제어명령신호(TPC)를 입력하고, 그 입력된 신호에 의거하여 송신전력의 크기를 제어하는 송신전력제어부(37): 상기 송신전력제어부(37)의 제어에 따라 변조기(38)를 통해 변조된 역방향 신호의 전력 레벨을 조정/증폭하여 출력하는 종단 고출력증폭기(HPA)(39)로 구성되어 있다.

도 4는 본 발명의 일 실시예에 따른 CDMA 시스템의 역방향 폐루프 전력 제어 방법의 흐름도로서, 도 3과 같은 장치에 의해 구현되므로 상기 장치의 작용 설명과 함께 병행하여 설명하면 다음과 같다.

먼저, 기지국으로부터 송신되어 이동국에 수신된 순방향신호는 상기 자동이득조정 증폭기(31)에 입력되어 이득 조정된 후, 상기 채널추정기(32) 및 상기 복조기(35)에 동시 입력된다(S1). 상기 채널추정기(32)는 상기 수신된 순방향 신호의 채널 중 파일럿 채널의 전력 크기와 위상을 추정하고, 이와 동시에 상기 복조기(35)는 상기 순방향신호에서 송신전력제어명령신호(TPC)를 복조한다(S2).

상기 속도 추정기(33)는 상기 채널추정기(32)에 의해 채널 추정된 파일럿 채널의 전력 크기와 위상에 의거하여, 후술되는 방법에 따라 이동국의 이동속도를 추정하고, 이와 아울러 상기 검증부(36)는 상기 복조기(35)에 의해 복조된 송신전력 제어명령비트(TPC)의 내력(history) 및 해당 비트의 에너지로부터 해당 TPC 비트의 신뢰도를 산출한다(S3). 예를 들어, TPC의 내력 중 rkRKdns 값에는 더 큰 값의 가중치를 부여하고, 검출되는 에너지에는 비례하는 다음과 같은 신뢰도 추정식에 따라 신뢰도를 계량화 한다.

$$\text{신뢰도} = \frac{\sum_{i}^{N} a_i TPC_i}{N} W_1 + E_{TPC} W_2$$

(여기서, i가 작을수록 가까운 시간대를 의미하며, $a_i > a_{i+1}$의 관계식을 갖는다. 그리고, N은 신뢰도에 관여시킬 TPC 샘플 수를 나타내고, E_{TPC}는 현재 감출된 TPC에 대한 에너지 값이며, W1과 W2는 신뢰도에 영향을 미치는 TPC 내력과 TPC에너지간의 비를 나타내는 것으로서, 바람직하게는 W1<W2 이다.)

상기와 같은 수식에 따라 계량화된 신뢰도는 이후에 송신전력 제어스텝의 크기에 대한 가중치로서 사용된다.

이어, 상기 송신전력제어스텝 조정부(34)는 상기 속도 추정기(33)에 의해 추정된 상기 이동속도에 의거하여 이동국의 송신전력제어스텝(△P)의 크기를 매 1.25msec마다 0.25dB 내지 2dB 범위내에서 가변 증감되도록 세팅(setting)하되, 이동국의 속도가 빠르면 전력 추종을 빠르게 하기 위해 송신전력 제어스텝(△P)을 1dB 또는 그 이상으로 하고, 이동국의 속도가 느리거나 정지해 있으면 그 스텝을 0.25dB

또는 그 이하로. 그리고 속도가 중간 정도이면 0.5dB로 세팅한다. 바람직하게 상기 송신전력제어스텝을 0.25dB 또는 0.5dB과 1dB에서 선택적으로 세팅하여 세팅된 크기 단위로 증감될 수 있도록 조정한다(S4).

마지막으로. 상기 송신전력제어부(37)는 상기 송신전력제어스텝 조정부(34)에 의해 조정되어 셋팅된 송신전력제어스텝(△P) 및 상기 검증부(36)에 의해 검증된 송신전력제어명령신호(TPC 1비트 : '0' 또는 '1')에 의거하여 상기 고출력증폭기(39)를 통해 출력되는 역방향 신호의 송신전력을 제어한다(S5).

한편. 상기 속도 추정기(33)는 상기 이동국의 속도를 다음과 같은 방법에 의해 추정하게 된다.

레벨크로싱레이트는. $n(\gamma-A) = N/T$ 이고.

여기서. A는 기준레벨(reference level)이고. N은 # of crossings over T - second length 이다.

평균페이드시간은. $t(r-A)=\frac{\sum_{i=0}^{N} t_i}{N}$ 이고. 여기서 t_i는 individual fade이다.

이동국의 송신전력세기(P_n)은 $P_n = Pn-1 + (TPC \times W \times N \times \triangle P)$이며. 여기서 TPC는 송신전력제어명령비트(Sign of TPC bit(±1)). W는 TPC비트의 신뢰도(Weight for the reliability of TPC bit). N은 min(C. $\triangle P_{max}/\triangle P$). C는 # of the TPC bits which indicate a power change in the same direction. $\triangle P_{max}$는 Maximum increasement. △P는 송신전력제어스텝 크기(Step Size)를 나타낸다.

특허청구범위

1. 부호분할 다중접속 시스템의 역방향 페루프 전력 제어 장치에 있어서.

수신된 순방향 신호의 특정 채널의 전력크기와 위상을 추정하는 채널추정수단;

상기 추정된 신호의 전력 크기와 위상에 의거하여 이동국의 이동속도를 추정하는 속도추정수단;

상기 추정된 속도에 의거하여 이동국의 송신전력제어스텝의 크기를 가변적으로 조정하는 송신전력제어스텝 조정수단;

상기 수신된 순방향 신호에서 송신전력제어명령신호를 복조하는 복조수단; 및

상기 조정된 송신전력제어스텝 및 상기 송신전력제어명령신호에 의거하여 송신전력을 제어하는 송신전력제어수단을 포함하여 구성된 것을 특징으로 하는 부호분할 다중접속 시스템에서의 역방향 링크의 전력 제어 장치.

2. 제 1 항에 있어서. 상기 특정 채널은 파일럿 채널인 것을 특징으로 하는 부호분할 다중접속 시스템에서의 역방향 링크의 전력 제어 장치.

3. 제 1 항에 있어서. 상기 복조된 송신전력 제어명령신호의 신뢰성을 산출하는 산출수단을 더 포함하여 구성되되. 상기 송신전력 제어수단은 상기 산출된 신뢰성에 따른 가중치를 송신전력 제어스텝에 연산하고. 이에 따른 상기 송신전력 제어신호에 따라 송신전력을 증가 또는 감소시키는 것을 특징으로 하는 부호분할 다

중접속 시스템에서의 역방향 링크의 전력 제어 장치.

4. 제 3 항에 있어서. 상기 산출수단은 수신되는 송신전력제어비트들의 내력(history) 및 해당비트의 에너지의 크기에 의거하여 상기 해당비트의 신뢰성 정도를 산출하는 것을 특징으로 하는 부호분할 다중접속 시스템에서의 역방향 링크의 전력 제어 장치.

5. 제 3 항에 있어서. 상기 송신전력 제어수단에 의해 제어된 상기 송신전력의 세기(P_n)는 수학식 "$P_n = Pn-1 + (TPC \times W \times N \times \Delta P)$"에 의해 결정되며. 여기서 TPC는 송신전력제어명령비트(Sign of TPC bit(±1)). W는 TPC비트의 신뢰도(Weight for the reliability of TPC bit). N = min(C. $\Delta P_{max}/\Delta P$). C는 # of the TPC bits which indicate a power change in the same direction. ΔP_{max}는 Maximum increasement. ΔP는 송신전력제어스텝 크기(Step Size)를 나타냄 특징으로 하는 부호분할 다중접속 시스템에서의 역방향 링크의 전력 제어 장치.

6. 부호분할 다중접속 시스템의 역방향 페루프 전력 제어 방법에 있어서.

순방향 신호를 수신하는 제 1 단계:

상기 수신된 순방향 신호의 특정채널의 전력크기와 위상을 추정함과 아울러. 그 순방향신호에서 송신전력제어명령신호를 복조하는 제 2 단계:

상기 추정된 크기와 위상에 의거하여 이동국의 이동속도를 추정하는 제 3 단계:

상기 추정된 이동국의 이동속도에 따라 이동국의 송신전력제어스텝의 크기

를 설정하는 제 4 단계: 및

상기 설정된 송신전력제어스텝 및 상기 복조된 송신전력제어명령신호에 의거하여 역방향 신호의 송신전력을 제어하는 제 5 단계를 포함하여 구성된 것을 특징으로 하는 부호분할 다중접속 시스템에서의 역방향 링크의 전력 제어 방법.

7. 제 6 항에 있어서, 상기 제 4 단계는, 상기 송신전력제어스텝의 크기를 매 1.25msec마다 결정하는 것을 특징으로 하는 부호분할 다중접속 시스템에서의 역방향 링크의 전력 제어 방법.

8. 부호분할 다중접속 시스템의 역방향 폐루프 전력 제어 방법에 있어서,

순방향 신호를 수신하는 제 1 단계:

상기 수신된 순방향 신호에서 송신전력제어명령신호를 복조하는 제 2 단계:

상기 복조된 송신전력제어명령신호의 신뢰도를 산출하는 제 3 단계:

상기 산출된 신뢰도에 따라 가중치를 결정하여 기 설정된 송신전력제어스텝과 연산하는 제 4 단계: 및

상기 송신전력제어명령신호에 의거하여, 상기 연산에 의해 크기 조정된 송신전력제어스텝만큼 역방향 신호의 송신전력을 제어하는 제 5 단계를 포함하여 구성된 것을 특징으로 하는 부호분할 다중접속 시스템에서의 역방향 링크의 전력 제어 방법.

요약서

본 발명은 역방향 링크에서의 송신전력제어스텝의 크기 및 최종 송신전력 제어증감을 가변 제어함으로써, 역방향 폐루프 전력제어 기술을 개선하는 부호분할 다중 접속 시스템에서의 역방향 링크의 전력 제어 장치 및 방법에 관한 것으로서, 수신된 순방향 신호의 특정 채널의 크기와 위상을 추정하는 채널추정기(32); 상기 추정된 신호의 크기와 위상에 의거하여 이동국의 이동속도를 추정하는 속도추정기(33); 상기 추정된 속도에 의거하여 이동국의 송신전력제어스텝의 크기를 가변적으로 조정하는 송신전력제어스텝 조정부(34); 상기 수신된 순방향 신호에서 송신전력제어명령신호(TPC)를 복조하는 복조기(35); 상기 복조된 송신전력제어명령신호의 신뢰도를 검증하는 검증부(36); 및 상기 조정된 송신전력제어스텝 및 상기 검증된 송신전력제어명령신호에 의거하여 송신전력을 제어하는 송신전력제어부(37)를 포함하여 구성되어, 역방향 송신 신호의 전력 레벨을 최적화하고, TPC 오류에 의한 역방향 신호 품질의 저하를 최소화하는 효과가 있다.